> "As an example, Fig. 14 shows the substrate 304 rotated by an angle α about the *x* axis and Figs. 15A and 15B show the substrate rotated by an angle α about the *x* axis and by an angle ß about the *y* axis. Accordingly, the substrate/target angle or sputtering angle comprises angles α and ß wherein the planes formed by these angles are orthogonal with respect to one another. As shown in Figs. 15A and 15B and as described in examples hereinabove α may be 40° and β may be in a range of 10°-30°."

The Examiner objected to the drawings on the basis that the drawings do not show every feature claimed in that the angle α being 40° and the angle β being in the range of 10°-30° with the angles being orthogonal with respect to one another has not been shown. Fig. 15A is the same as Fig. 14 except the substrate 308 has been rotated about the *y* axis by an angle β in a view taken from the right of and partially down on Fig. 14. Fig. 15A has been amended to show that the substrate 308 has been rotated by the angle α = 40° and by an angle β which is equal to 10°-30°. In order to further clarify this relationship the Applicant submits for the Examiner's approval Fig. 15B which is the same as Fig. 14 except the substrate 308 has been rotated by an angle β which is equal to 10°-30°. Pages 8 and 14 of the specification have been amended to more fully describe Figs. 15A and Fig. 15B.

Claims 32, 36-39, 41, 42, 44, 46, 48, 49, 51, 53, 56-58, 61, 62, 64-70, 73, 76-78, 81, 82 and 84-90 were rejected under 35 USC 112, first paragraph as containing subject matter which is not described in the specification in such a way to reasonably convey to one skilled in the art that the inventor possessed the claimed invention. The Applicant submits that the amendments to the specification and the drawings more fully state the Applicant's possession of the claimed invention and should overcome the rejection of these claims under 35 USC 112, first paragraph.

Claims 71 and 72 were rejected under 35 USC, second paragraph as being indefinite on the basis that claims 71 and 72 depend from cancelled claims. Claim 71 has been amended to be dependent upon claim 32 and claim 72 has been amended to be dependent upon claim 41 in order to overcome this rejection.

Claims 34, 40, 55, 59, 60 and 63 were rejected under 35 USC 103(a) as being unpatentable over Lin in view of Pinarbasi and Fujikata. Amended claim 34 is distinguished over these references by reciting:

> "the pinning layer structure being formed by forming a nickel oxide (NiO) layer and an alpha iron oxide (α FeO) layer wherein each of the nickel oxide (NiO) layer and the alpha iron oxide (α FeO) layer has been formed by oblique ion beam sputtering at angles α and β wherein angles α and β form first and second planes respectively which are orthogonal with respect to one another."

In support of his rejection the Examiner refers to Fig. 2 of Pinarbasi and states:

> " . . . . ***The substrate or other workpiece 51 is mounted on a movable pedestal or support member 41*** which is retrieved into a loading port 39 via a gate valve; 38 for changing the workpiece 51. The pedestal 41 may also be temperature controlled, i.e., heated or cooled or both. ***A magnetic field may also be applied at the workpiece 31 if required for the particular structure being deposited.*** The pedestal 41 may also be rotated by means of a linear/rotary motor drive (not shown). . . ."

The Applicant maintains that the pedestal 41 in Fig. 2 of Pinarbasi can only rotate about a vertical axis (not shown) which is incapable of providing the angle β as set forth in claim 34. Further in support of his rejection and apparently referring to Fig. 9 of Pinarbasi the Examiner states:

> "***The primary ion source comprises a 12 cm Kaufman ion source adjustably mounted to provide a variable angle of incidence of the ion beam on the target 91 over a range of 0 degrees, i.e., normal to the target, to about 60 degrees.*** (Column 12 lines 46-49) ***Oblique sputtering occurs in the range of 0 to 60 degrees. Since Pinarbasi teach an angle of 0 to 60 degrees which is representative of the α angle and suggest no ranges of other angles it is believed that such "no suggestion" of other angles must include a β angle of 0 degrees. Since a β angle of 0 degrees can exist in a plane perpendicular to the plane containing the α angle it is believed this suggests Applicant's claim limitation. It should be noted that Applicant's β angle can be 0 degrees.***"

Amended claim 34 states that the angles α and β form first and second planes respectively which are orthogonal with respect to one another. The Applicant respectfully submits that claim 34 as amended overcomes the objection of the Examiner since angle β has to form a plane and cannot be equal to 0 degrees. A "β angle of 0 degrees" is in essence not an angle at all and therefore does not form a plane. Further in support of his rejection the Examiner states:

"Fujikata et al. teach utilizing an antiferromagnetic thin film comprised of a two-layer structure composed of a CoO layer deposited on a NiO layer. (See Abstract) As the additional antiferromagnetic layer for stabilization of the magnetic domains, those materials such as FeMn, NiMn, NiO, CoO, Fe2O3, FeO, CrO, and MnO are preferred. (Column 6 lines 2-5)"

Applicant's claim 34 is clearly distinguished from Fujikata by reciting the alpha phase of iron oxide (αFeO) in contrast to ferric oxide (Fe_2O_3 or FeO) as taught by Fujikata. Claim 34 is still further distinguished over Fujikata by reciting the pinning layer structure as including two layers, namely a nickel oxide (NiO) layer and an alpha iron oxide (αFeO) layer. In contrast, Fujikata places his iron oxide layer next to his free layer instead of placing his iron oxide layer next to his pinning layer. In this regard, the Examiner's attention is respectfully invited to column 1, lines 30-37 and column 5, line 60 to column 6, line 11 of Fujikata wherein it is stated:

"Recently, proposal is made of a magnetoresistance effect film which comprises at least two ferromagnetic layers or thin films stacked one over the other with a nonmagnetic layer or thin film interposed therebetween, and an antiferromagnetic layer or thin film underlying a first one of the ferromagnetic thin films so that the first ferromagnetic thin film is provided with antimagnetic force, that is, constrained by exchange anisotropy or exchange biasing.

. . . .

In the above-mentioned magnetoresistance effect film, an additional antiferromagnetic layer or a permanent magnet layer may be arranged adjacent to the second ferromagnetic layer which is for detecting the external magnetic field so that a biasing magnetic direction by the permanent magnet or the additional antiferromagnetic layer is in the direction of the easy magnetization axis of the second ferromagnetic layer. With this structure, magnetic domains of the second ferromagnetic layer can be stabilized so that nonlinear outputs such as Barkhausen jumps can be avoided. As the additional antiferromagnetic layer for stabilization of the magnetic domains, those materials such as FeMn, NiMn, NiO, CoO, Fe_2O_3, FeO, CrO, and MnO are preferred. As the permanent magnet layer, those materials such as CoCr, CoCrTa, CoCrTaPt, CoCrPt, CoNiPt, CoNiCr, CoCrPtSi, and FeCoCr are preferred. Furthermore, Cr or the like may be used as a primer or an underlying layer for the permanent magnet layer."

In the first part of the quote Fujikata refers to a first ferromagnetic thin film which is pinned by a ferromagnetic layer and a second ferromagnetic layer wherein the first and second ferromagnetic layers are spaced apart by a nonmagnetic spacer layer. The latter part of the quote refers to placing

a ferric oxide layer next to the second ferromagnetic layer which is the free layer, not the pinned layer. Claim 34 recites the ferric oxide layer as being part of the pinning layer structure in contrast to being located next to the free layer as taught by Fujikata. The teaching that Fujikata provides is employment of the antiferromagnetic layers (or hard bias layers as known in the art) as seen in Figs. 1 and 2 of Fujikata for stabilizing the magnetic domains of the free layer 2.

Claims 74 and 75 were rejected under 35 USC 103(a) as being unpatentable over Pinarbasi. Amended claim 74 is distinguished over Pinarbasi by reciting:

> "positioning the planar surfaces at angles α and β with respect to one another wherein angle α forms a first plane intersecting the first and second planar surfaces and angle β forms a second plane intersecting the first and second planar surfaces as well as the first plane with the intersection of the first and second planes being orthogonal with respect to each other; and"

In the same manner as discussed hereinabove in regard to claim 34, claim 74 has been amended to recite the angles α and β as forming first and second planes which are orthogonal with respect to one another. Claim 74, as amended, and dependent claim 75 are now clearly distinguished over Pinarbasi.

Claims 79-83 were rejected under 35 USC 103(a) as being unpatentable over Pinarbasi in view of Lin. Claims 79 and 83, which are dependent upon claim 74, are considered to be patentable over these references for the same reasons as given in support for claim 74. Further, Lin only teaches one copper layer next to a free layer or a pinned layer in contrast to a nickel iron film which is being located between first and second cobalt based films, as recited in claim 79.

Claim 80 was rejected under 35 USC 103(a) as being unpatentable over Pinarbasi in view of Lin and further in view of Fujikata. The Applicant maintains that claim 80 is distinguished over these references for the same reasons as given in support for claim 34 over Pinarbasi and Fujikata.

In the Examiner's "*RESPONSE TO ARGUMENTS*" he states:

> "In response to the argument that the references do not teach oblique sputtering, it is argued that since Pinarbasi teach an angle of 0 to 60 degrees which is representative of the α angle and suggest no ranges of other angles it is believed that such "no suggestion" of other angles must include a β angle of 0 degrees. Since a β angle of 0 degrees can exist in a plane perpendicular to the plane containing the α angle it is believed this suggests Applicant's claim limitation. It should be noted that Applicant's β angle can be 0 degrees."

The Applicant has amended the claims to recite the angles α and β as forming first and second planes respectively which are orthogonal with respect to one another. This feature is shown in Figs. 15A and 15B wherein the substrate has been rotated about axis x by an angle α and has further been rotated about an axis y by an angle β. As shown in Figs. 15A and 15B α can be equal to 40° and β can be in a range from 10°-30°. The Applicant maintains that these amendments overcome his objection as stated in the "*RESPONSE TO ARGUMENTS*".

Should the Examiner have any questions regarding this Amendment he is respectfully requested to contact the undersigned.

Respectfully submitted,

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#15 attach

ATTACHMENT

In the specification

Page 8, line 16, after substrate delete ";" and add --with the substrate rotated by angle α with respect to the target;-- .

Page 8, line 17, delete the paragraph "Fig. 15 is a view taken along plane 15-15 of Fig. 14" and insert the following paragraphs:

--Fig. 15A is a perspective view looking from the right of and partially down on Fig. 14 with the ion beam gun enlarged and with the substrate rotated by angle β in addition to angle α;

Fig. 15B is the same as Fig. 14 except the substrate has been rotated by angle β;-- .

Page 14, line 3, delete "Fig. 15 shows" and substitute therefor --Figs. 15A and 15B show--;

line 4, after "an" insert --angle α about the *x* axis and by an-- , and delete "In this example" and substitute therefor --Accordingly,-- ;

line 5, delete "." and insert --wherein the planes formed by these angles are orthogonal with respect to one another. As shown in Figs. 15A and 15B and as described in examples hereinabove α may be 40° and β may be in a range of 10°-30°.-- ;

line 7, delete "14 and 15" and substitute therefor --14, 15A and 15B-- .

In the claims:

Amend claims 32, 34, 40, 41, 46, 48, 51, 55, 64, 69, 71, 72, 74 and 89.

32. (Once Amended) A method of making a magnetic read head, which includes a spin valve sensor, comprising the steps of:

a making of the spin valve sensor comprising the steps of:

forming a free layer structure that has a magnetic moment and an easy axis;

forming a ferromagnetic pinned layer structure that has a magnetic moment;

forming a pinning layer exchange coupled to the pinned layer structure for pinning the magnetic moment of the pinned layer structure;

forming a nonmagnetic conductive spacer layer between the free layer structure and the pinned layer structure;

forming the free layer structure by obliquely ion beam sputtering at least one cobalt or cobalt based layer in the presence of a magnetic field oriented in a direction of said easy axis; and

the oblique ion beam sputtering being at angles α = 40° and β = 10° - 30°, wherein angles α and β form first and second planes respectively which are orthogonal[.] with respect to one another.

34. (Thrice Amended) A method of making a magnetic read head, which includes a spin valve sensor, comprising the steps of:

a making of the spin valve sensor comprising the steps of:

forming a free layer structure that has a magnetic moment and an easy axis;

forming a ferromagnetic pinned layer structure that has a magnetic moment;

forming a pinning layer exchange coupled to the pinned layer structure for pinning the magnetic moment of the pinned layer structure;

forming a nonmagnetic conductive spacer layer between the free layer structure and the pinned layer structure;

forming the free layer structure by obliquely ion beam sputtering at least one cobalt or cobalt based layer in the presence of a magnetic field oriented in a direction of said easy axis;

the pinning layer structure being formed by forming a nickel oxide (NiO) layer and an alpha iron oxide (α FeO) layer wherein each of the nickel oxide (NiO) layer and the alpha iron oxide (α FeO) layer has been formed by oblique ion beam sputtering at angles α and β wherein angles α and β <u>form first and second planes respectively which</u> are orthogonal with respect to one another.

40. (Twice Amended) A method of making a magnetic read head, which includes a spin valve sensor, comprising the steps of:

forming the spin valve sensor as follows:

forming a ferromagnetic pinned layer structure that has a magnetic moment;

forming a pinning layer exchange coupled to the pinned layer structure for pinning the magnetic moment of the pinned layer structure;

forming a nonmagnetic conductive spacer layer between the free layer structure and the pinned layer structure; and

forming the pinning layer structure of a nickel oxide (NiO) layer and an alpha iron oxide (αFeO) layer wherein at least one of the nickel oxide (NiO) layer and the alpha iron oxide (αFeO) layer has been obliquely ion beam sputtered at angles α and β wherein angles α and β <u>form first and second planes respectively which</u> are orthogonal with respect to one another.

41. (Thrice Amended) A method of making a magnetic read head, which includes a spin valve sensor, comprising:

a making of the spin valve sensor including the steps of:

forming a free layer structure that has a magnetic moment and an easy axis;

forming a ferromagnetic pinned layer structure that has a magnetic moment;

forming a pinning layer exchange coupled to the pinned layer structure for pinning the magnetic moment of the pinned layer structure;

forming a nonmagnetic conductive spacer layer between the free layer structure and the pinned layer structure;

a making the free layer structure including the steps of:

obliquely ion beam sputtering first and second cobalt or cobalt based layers and a nickel iron based layer in the presence of a magnetic field oriented in a direction of said easy axis with the first and second cobalt or cobalt based layers interfacing the spacer layer and a cap layer respectively and the nickel iron based layer being located between and interfacing the first and second cobalt or cobalt based layers;

the oblique ion beam sputtering being at angles $\alpha = 40°$ and $\beta = 10° - 30°$ wherein angles α and β form first and second planes respectively which are orthogonal[;] with respect to one another; and

after said oblique ion beam sputtering in the presence of said field oriented in said direction on the easy axis, annealing each of the cobalt or cobalt based layers and the nickel iron based layer.

46. (Twice Amended) A method as claimed in claim 44 wherein the step of oblique ion beam sputtering includes the steps of:

providing a sputtering chamber;

providing a nonmagnetic conductive target in the sputtering chamber that has a nominal planar surface;

positioning a substrate in the chamber that has a nominal planar surface at [an angle] angles α and β to the nominal planar surface of the target;

providing an ion beam gun in the chamber for bombarding the target with ions which causes ions of the material to be sputtered from the target and deposited on the substrate to form said cobalt or cobalt based layers; and

[the sputtering being at] angle[s] $\alpha = 40°$ and angle $\beta = 10° - 30°$ wherein angles α and β form first and second planes respectively which are orthogonal with respect to one another and are angles between the nominal surface planes of the target and the substrate.

48. (Thrice Amended) A method of making magnetic head assembly that includes a write head and a read head, comprising the steps of:

a making of the write head including:

forming ferromagnetic first and second pole piece layers in pole tip, yoke and back gap regions wherein the yoke region is located between the pole tip and back gap regions;

forming a nonmagnetic nonconductive write gap layer between the first and second pole piece layers in the pole tip region;

forming an insulation stack with at least one coil layer embedded therein between the first and second pole piece layers in the yoke region; and

connecting the first and pole piece layers at said back gap region; and

making the read head as follows:

forming a spin valve sensor and first and second nonmagnetic first and second read gap layers with the spin valve sensor located between the first and second read gap layers;

forming a ferromagnetic first shield layer; and

forming the first and second read gap layers between the first shield layer and the first pole piece layer; and

a making of the spin valve sensor comprising the steps of:

forming a free layer structure that has a magnetic moment and an easy axis;

forming a ferromagnetic pinned layer structure that has a magnetic moment;

forming a pinning layer exchange coupled to the pinned layer structure for pinning the magnetic moment of the pinned layer structure;

forming a nonmagnetic conductive spacer layer between the free layer structure and the pinned layer structure;

a making of the free layer structure including the step of:

obliquely ion beam sputtering first and second cobalt or cobalt based layers and a nickel iron based layer in the presence of a magnetic field oriented in a direction of said easy axis with the first and second cobalt or cobalt based layers interfacing the spacer layer structure and a gap layer respectively and the nickel iron based layer being located between and interfacing the first and second cobalt or cobalt based layers;

the oblique ion beam sputtering being at angles $\alpha = 40°$ and $\beta = 10° - 30°$ wherein angles α and β <u>form first and second planes respectively which</u> are orthogonal[;] <u>with respect to one another;</u> and

after said oblique ion beam sputtering in the presence of said field oriented in said direction of the easy axis, annealing each of the cobalt or cobalt based layers and the nickel iron based layer.

51. (Once Amended) A method as claimed in claim [49] <u>48</u> wherein a forming of the pinned layer structure comprises the steps of:

forming ferromagnetic first and second antiparallel (AP) pinned layers with the first AP pinned layer interfacing the pinning layer; and

forming an antiparallel (AP) coupling layer located between the first and second AP layers.

55. (Once Amended) A method of making a magnetic layer and/or an antiferromagnetic (AFM) layer for an electrical device comprising the steps of:

obliquely ion beam sputtering at least one material layer from a target onto a substrate to form said magnetic layer and/or antiferromagnetic (AFM) layer;

the oblique ion beam sputtering being at angles α and β wherein each angle α and β is acute and wherein the angles α and β <u>form first and second planes respectively which</u> are orthogonal with respect to each other.

64. (Once Amended) [A method as claimed in claim 63 wherein for the free layer the angle β is] <u>A method as claimed in claim 55 wherein the electrical device is a magnetic head assembly and further comprises:</u>

<u>said at least one material layer being a ferromagnetic free layer;</u>

<u>forming a ferromagnetic pinned layer;</u>

<u>forming a nonmagnetic spacer layer between the free and pinned layers; and</u>

<u>the pinned and spacer layers being ion beam sputtered at an angle α which is acute and at an angle β which is</u> 10° to 30°.

69. (Once Amended) A method as claimed in claim 68 further including the steps of:

forming said antiferromagnetic (AFM) layer interfacing the pinned layer wherein the AFM layer includes a nickel oxide film and an α phase iron oxide film that interface one another; and

ion beam sputtering the nickel oxide film and the α phase iron oxide film at angles α and β wherein each angle α and β are acute and wherein the angles α and β form first and second planes respectively which are orthogonal with respect to one another.

71. (Once Amended) A method as claimed in claim [1] 32 wherein the forming of the spacer layer includes oblique ion beam sputtering copper at angles α = 40° and β = 10° – 30° with angles α and β being orthogonal.

72. (Once Amended) A method as claimed in claim [21] 41 wherein the forming of the spacer layer includes oblique ion beam sputtering copper at angles α = 40° and β = 10° – 30° with angles α and β being orthogonal.

74. (Once Amended) A method of ion beam sputtering at least one layer comprising the steps of:

providing a substrate with a first planar surface;

providing at least one target with a second planar surface wherein the target is composed of a desired material for said layer;

positioning the planar surfaces at angles α and β with respect to one another wherein angle α [is in] forms a first plane intersecting the first and second planar surfaces and angle β [is in] forms a second plane intersecting the first and second planar surfaces [and] as well as the first plane with the intersection of the first and second planes being orthogonal with respect to each other; and

ion beam sputtering the target so that said material is sputtered from the target onto said substrate to form said layer.

89. (Once Amended) A method as claimed in claim 88 further comprising:

forming an antiferromagnetic (AFM) layer interfacing the pinned layer wherein the AFM layer includes a nickel oxide film and an α phase iron oxide film that interface one another; and

ion beam sputtering the nickel oxide film and the α phase iron oxide film at angles α and β wherein each angle α and β are acute and wherein the angles α and β form first and second planes respectively which are orthogonal with respect to one another.